Now, under the conditions of mammalian life—conditions in which survival of the fittest attains within its limited sphere of operation a maximum degree of efficiency—it is obvious that diminution of activity would be fatal, the speed of mammals being one of the most important conditions to survival in the struggle for existence (as is shown by the fact that this trait is so highly developed in these animals); hence, a less degree of activity being prohibited, any decrease in the mass of the ovary would be of service to the organism in which it occurred. Natural selection may legitimately be supposed to operate here, since, although it has been clearly demonstrated that the higher the life of the organism the less range of application does this principle possess, yet it doubtless applies in the case of any feature which is of paramount importance, and modifications concerned with the genital structures must necessarily possess such importance. It is therefore possible, and even probable, that the loss of yolk suffered by the mammalian ovary and the alternative adoption of a placental mode of nutrition both indirectly result from that same cause of impulsive locomotion to which we have traced several other features of mammalian structure.

It may also be worth while to add that many minor features of mammalian anatomy, the significance of which is usually overlooked, are only explicable on the assumption that they are related to impulsive locomotion. Instances of these minor structures are: the accumulation of fat at the base of the heart, the fatty cushion surrounding the neck of the bladder, the fatty development about the kidney already noticed, and the various "suspensory ligaments" and other "fixative organs" referred to above, associated with the stomach, liver, and other viscera of large mass.

5. On the Geographical Distribution of Spiders of the Order Mygalomorphæ. By R. I. Pocock, F.Z.S.

[Received March 17, 1903.]

(Text-figures 58–61.)

Part I.

Introductory Remarks upon the Palæontology and the Means of Dispersal of Spiders.

(*a*) Summary of the Palæontological History of Spiders, and its bearing on the Phenomena of Distribution.

Owing to the enormous chances against the preservation of fossil Spiders in sedimentary rocks, the palæontological history of this Order is very imperfect. One or two types have been discovered in Carboniferous strata of Europe and North America (*Arthrolycosa* and *Protolycosa*), and also a fairly large number of specimens from amber and from gypsum and lacustrine deposits of Oligocene and Miocene age in those countries. But absolutely

nothing is known of the forms that inhabited the world during the enormous lapse of time represented by the Mesozoic strata, and nothing except inferentially of the types that occupied the southern countries of the world during Tertiary times.

Spiders of the type that lived in the Carboniferous period succeeded in holding their own in Europe until the Oligocene, and are represented at the present time by the genus *Liphistius*, which is restricted to the Indo-Malayan area of the Oriental Region.

Apart from the genus *Liphistius*, all existing Spiders, including the Mygalomorphæ, belong to the group Opisthothelæ. There is no evidence that this group existed in the Carboniferous period; but since most of the Oligocene and Miocene fossils belong to existing families, or sometimes indeed to existing genera, it is permissible to suppose that the Opisthothelæ originated some time during the Mesozoic epoch, and may, in fact, be coeval with the mammalia. Whether any of these hypothetical Mesozoic forms survive to the present day, it is quite impossible to say. All that palæontology allows us to infer is that during the Tertiary period there was a rich and varied spider-population spread over the Northern hemisphere, containing forms that have undergone but little metamorphosis since that date. The existence of Mygalomorphæ at that time is attested by the discovery of one form referred to *Mygale* in the gypsum-beds at Aix, and of another, *Eoatypus*, in the Eocene strata at Garnet Bay in the Isle of Wight. But since it is impossible to classify these forms with an approach to certainty in any of the existing families, their only value from the geographical standpoint is the evidence they supply that the Mygalomorphæ had come into being in Tertiary times, and were living in the Northern hemisphere.

The imperfections in our knowledge above alluded to permit only a provisional acceptance of the theories put forward in the following pages to explain the distributional phenomena of the Mygalomorphæ. But all the available evidence, little enough though it be, points to the conclusion that the Mygalomorphæ and the rest of the Opisthothelæ appeared first in the Northern hemisphere, and spread thence over the southern countries of the world.

(*b*) Means of Dispersal of Spiders, and the importance of the Mygalomorphæ from the Geographical standpoint.

It cannot be claimed that Spiders as a whole are a favourable group to study from a geographical point of view; for, although exclusively terrestrial when adult, and, like other flightless animals, dependent upon continuity of land-surfaces for migration, a great many species are known to have the power, and the instinct to put it in force, of dispersing themselves over wide areas by practising when young the habit of flight, using silk-threads as aerial floats upon which they may be carried long distances before the wind. This phenomenon is well known, and has given rise to

the belief in the existence of a 'gossamer' spider which is supposed to be the cause of the fine threads which fall from the air and carpet the fields with silk at certain times of the year. It is now known that the 'gossamer' spider is a mythical species, and that species of the most diverse habits belonging to widely different families are responsible for the floating threads. The habit is practised alike, and, so far as is known, to an equal extent, by snare-spinning forms belonging to the Argiopidæ and Theridiidæ, by hunting-spiders like the Lycosidæ and Attidæ, or by sedentary species that lurk in flowers, like the Thomisidæ.

That this method of locomotion may considerably influence the distribution of spiders may be inferred from the fact that cobwebs thrown out in this way, and affording support to little spiders, have been found at the tops of our highest buildings, and have become entangled in the rigging of ships 200 miles from land.

There are reasons for thinking, however, that the habit is for the most part restricted to phanerozoic diurnal species, namely, those that hunt their prey or spin their webs in the open; and that cryptozoic forms, that live in burrows or under stones or logs of wood, and that are for the most part nocturnal, do not indulge in it[1].

Clearly, therefore, these cryptozoic groups, in which the restrictions to dispersal are presumably the same as in other terrestrial animals which can neither fly nor swim to any distance, have more value for the establishment of geographical areas than those species with powers of dispersal analogous to flight.

Owing to the relatively large size and great weight of the newly hatched young of the Mygalomorphæ, coupled with the reduction in the number of spinning-appendages and the greater simplicity of the silk-glands, it seems probable that aerial sailing is not practised to any great extent by the members of this suborder[2]. Especially true will this be of the Avicularüidæ, a family which contains the largest spiders known of this or any other epoch, with newly-born young rivalling or excelling in size the adults of many species of the Arachnomorphæ.

Consideration of these facts, coupled with the impossibility of dealing in detail, in one paper, with the distribution of all the genera of the Araneæ, has led to the selection of the Mygalomorphæ as the fittest group to illustrate the geographical distribution of Spiders in general.

[1] Simon states that the Spider-fauna of the Sandwich Islands is composed wholly of species of the former category, with the exception of some few forms which appear to owe their presence in that Archipelago to human agency ('Fauna Hawaiiensis,' Araneæ, 1902).

[2] The young of the only known British representative of this group, namely *Atypus*, one of the smallest types of Mygalomorphæ, have been seen to scatter over small areas by this method of travelling (F. Enock, Tr. Ent. Soc. 1885).

In this connection it is instructive to remark that *Atypus* has a wider distribution than any other known genus of the suborder, ranging from Ireland and Algeria to Japan and over the Eastern (? the Western) States of North America, that is to say across the Northern hemisphere from the eastern to the western shores of the Atlantic.

Part II.

Distribution of the Families, Subfamilies, and Genera of Mygalomorphæ, *and the evidence thus supplied as to their Original Habitat and the Lines of Migration followed in Dispersal.*

Family Diplurid.æ.

The Diplurid.æ are the most widely distributed of all groups of Mygalomorphæ, being found practically all over the world to the south of about the 40th parallel of north latitude. The numerous groups, however, into which the genera fall present some features in their geographical range of considerable interest.

1. Subfamily Diplurinæ.—The genus *Brachythele*[1] is met with in the Mediterranean Region, Central Asia, and the Southern States of North America. Nearly allied to it are *Hapalothele* from Madagascar; *Brachytheliscus* from Natal; *Aname*, *Ixamatus*, *Chenistonia*, and *Dekana* from Australia and Tasmania; *Fufius* from Central and South America; *Trissothele* from Chili; *Lycinus* from the Argentine. South America is also the home of *Trechona*, *Diplura*, *Uruchus*, *Harmonicon*, and *Melodeus*.

2. Subfamily Macrothelinæ.—This subfamily is divisible into four groups.

(*a*) The Macrothelæ:—*Macrothele* occurs in Spain, China, Burma, Singapore, and Java. Nearly related are *Phyxioschæma* from Transcaspia, *Stenygrocercus* from New Caledonia and Queensland, and *Porrhothele* from New Zealand. *Ischnothele* is represented by species from India, Madagascar, S. & W. Africa, and Central and South America; and *Evagrus* is known from S. Africa and Central America, whence it extends into the Southern States of North America (Idaho).

(*b*) The Hexathelæ contain two genera—*Hexathele* from New Zealand, and *Scotinœcus* from Chili.

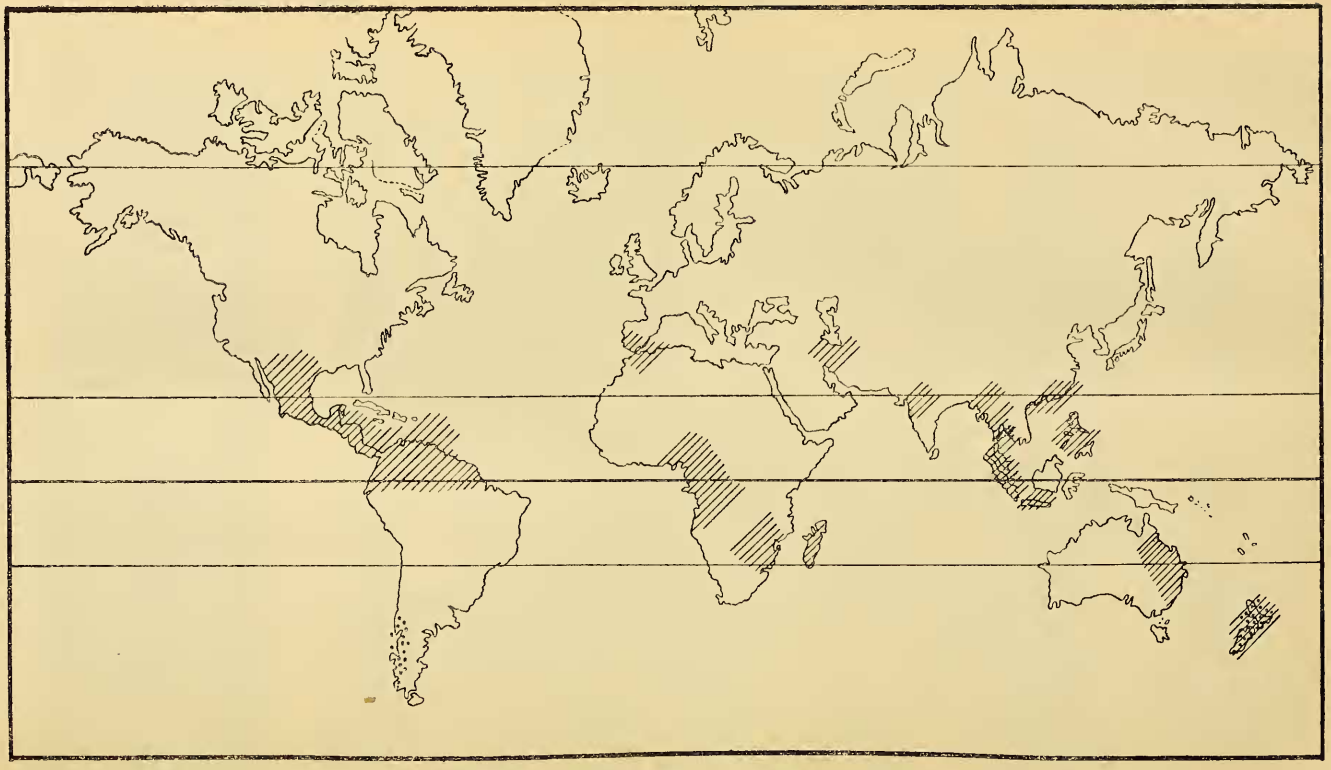
(*c*) The Atraces contain the genera *Atrax* and *Hadronyche*, from Eastern Australia.

(*d*) The Masteriæ, comprising *Accola* and *Masteria*, which are probably identical, occur in Venezuela, the Philippine Islands, and Upolu.

The presence of *Brachythele* in the Mediterranean and Sonoran areas, and of nearly allied forms in South Africa, Madagascar, and all over South America, suggests immigration from the north into these countries of the Southern hemisphere. On the other hand, the entire absence of related types from the area lying between and including India and Austro-Malaysia, and the reappearance in Australia of genera closely allied to *Brachythele*

[1] This genus has also been recorded from S. Africa, Madagascar, S. America, and Australia. It is probable, however, that the species referred to it belong to one or other of the allied genera from these areas.

Text-fig. 58.



Map to illustrate the Geographical Distribution of the Macrotheline genera of *Dipluridæ*.

Macrothelæ, Masteriæ, Atraces.

Hexathelæ.

as well as to the South-American and Afro-Mascarene forms, points equally forcibly to the peopling of Australia from either one or the other, or perhaps both, of the southern continents just mentioned.

The remaining genera of Diplurinæ, namely, *Trechona*, *Diplura*, *Harmonicon*, *Melodeus*, and *Uruchus*, all of which are more specialised types than *Brachythele* and its allies, probably arose within their present area of distribution.

A great contrast to the distribution of the Diplurinæ is presented by that of the Macrothelinæ.

The occurrence of *Macrothele* in Spain, China, Burma and Java; of *Porrhothele*, which is scarcely separable from it generically, in New Zealand; of *Phyxioschæma* in the Transcaspian area; and of its near ally, *Stenygrocercus*, in Queensland and New Caledonia, suggests a southward migration of these types from the northern provinces of the Old World into Australia and New Zealand by way of China and Indo-Malaysia. Similarly *Ischnothele*, a more specialised type than *Macrothele*, perhaps descended from the north by way of India into Madagascar, South Africa, and crossed thence into South America, where with *Evagrus*, which is also represented in South Africa, it is the only representative of this group of Diplurida. The entire absence from the Sonoran Region of forms related to *Macrothele*, *Evagrus*, and *Ischnothele*, is opposed to the supposition that the two last-mentioned genera had a northern origin in America.

The Masteriæ appear to be degenerate forms of the Macrothelæ. They are the smallest of all known Mygalomorphæ, and are essentially cryptozoic or lucifugous, living in caverns or under old decaying vegetation in the dark, damp forests. Hence we can only pretend to a partial knowledge of their distribution, and it would be rash to draw deductions from the fact of their having been discovered hitherto only in Venezuela, the Philippines, and Upolu.

The two genera of Atraces, *Atrax* and *Hadronyche*, confined to Australia, appear to be Macrothelinæ specialised for a fossorial life, with which is correlated certain features imparting to them a superficial similarity to the Ctenizidæ.

The Hexathelæ, resembling the Macrothelæ except in the retention of an additional pair of spinning-mamillæ, undoubtedly a primitive feature, are confined, so far as is known, to New Zealand and Chili. There seems no reason to doubt that they passed from one of these countries to the other by a southern land-connection.

Family Paratropidæ.

This family, specialised both in structure and habits, is represented by three genera, *Paratropis*, *Anisaspis*, and *Anisaspoides*, confined to the Neotropical Region. Its affinities are doubtful, but some primitive genus of Diplurida allied to *Brachythele* must

probably be looked to for its ancestry. There seems no reason to doubt that it originated in the area it now occupies.

Families Atypidæ, Brachybothriidæ, Mecicobothriidæ.

The genera of Atypidæ, two in number, scarcely pass south of the Equator. *Atypus*, occurring in the Mediterranean Region, and spreading northwards into Central Europe, beyond the 50th parallel of north latitude, is the most northern type of the Mygalomorphæ. It is also met with in Japan, Burma and Java, and in North America, where it ranges to the east of the Mississippi from Wisconsin (45th parallel of latitude) to Florida. *Calommata* is more restricted and more southern in range. It is confined to the Old World, and has been recorded from Japan, Siam, Burma, Sumatra, Java, and the Camaroon area of tropical West Africa.

The Brachybothriidæ contain the genera *Acattyma* from Japan, and *Brachybothrium* and *Atypoides* from North America, the latter from California, the former from British Columbia, North Carolina, Texas, &c.

The Mecicobothriidæ comprise two genera—*Hexura* from the two north-western States of North America (Washington and Oregon); and *Mecicobothrium* from the Argentine.

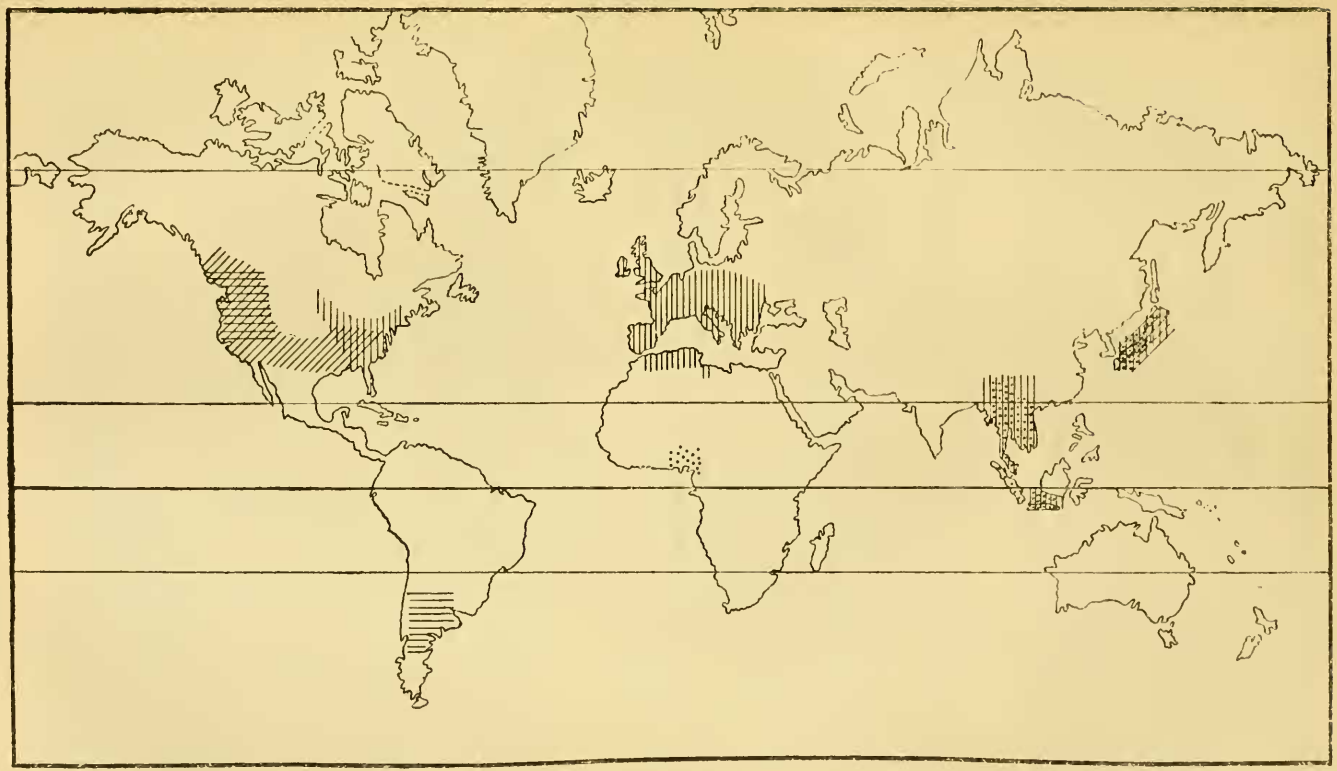
Atypus seems to be a genus which, like *Pachylomerus* and others, extended in Tertiary times sufficiently far to the north to avail itself of the land-connection that then existed across the area now covered by the Behring Sea. Its disappearance from the countries to the north of its present distributional area must be assigned to the refrigeration of this region of the globe with the advent of glacial conditions.

The distribution of *Calommata* in the eastern part of the Oriental Region and in Tropical West Africa has many parallels amongst the mammalia, and points to the former extension of the genus across an intervening forest-clad tract, and its survival in districts where the conditions remained favourable to its existence.

The explanation given of the distribution of *Atypus* applies equally to the Brachybothriidæ, except that *Atypoides* has no representative in the Old World. *Brachybothrium* extends in Western America northwards to Queen Charlotte Island, that is to say to the latitude of the Aleutian Islands and the Alaska Peninsula. Hence its similarity to, perhaps identity with, the Japanese *Acattyma* is no matter for surprise.

The apparently discontinuous distribution of the Mecicobothriidæ is very remarkable; but since the only known example of *Mecicobothrium* measures only 6 mm. in total length, it is highly probable that the existence of the genus in South America to the north of the Argentine has been overlooked. Considering the close structural similarity between *Hexura* and *Mecicobothrium*, and the admitted relationship between these two genera and the Brachybothriidæ and Atypidæ, both northern groups, it seems

Text-fig. 59.



Map to illustrate the Geographical Distribution of the *Atypidæ*, *Brachybothriidæ*, and *Mecicobothriidæ*.

Atypus. *Calommata.* *Mecicobothriidæ.* *Brachybothriidæ.*

probable that the Mecicobothriidæ first appeared in North America and penetrated thence into South America in the latter half of the Tertiary epoch.

The three families just discussed form an ascending series in specialisation, starting with *Hexura*, which leads from the Diplurida, passing through the Brachybothriidæ, thence to *Atypus*, and culminating with *Calommata*, the most specialised of all. Assuming, moreover, that *Acattyma* and *Brachybothrium* are identical, it is noticeable that of the six known genera, three are peculiar to the Western (American) hemisphere, two are common to both the Eastern and Western, and one only peculiar to the Eastern, namely *Calommata*. In other words, the most primitive genera are exclusively American, one that occupies an intermediate position (*Acattyma*) extends only as far as Japan, and the two genera of the most specialised Atypidæ extend from east to west throughout the Eastern hemisphere, and one of them, *Atypus*, to the extreme east of the Western hemisphere.

Since we should expect to find the primitive types of a group persisting in the area of its origin and the specialised forms in districts remote therefrom, the modifications being brought about by the varying conditions of existence incident to wandering, North America may be looked upon as the probable home of this section of the Mygalomorphæ.

If this be the explanation of their distribution, it presents analogies with that of the Camelidæ amongst the mammalia, which originated in the Sonoran area of America, and thence extended into South America and into Central Asia by way of Alaska and Kamchatka.

Family Cyrtaucheniidæ.

The genera of Cyrtaucheniidæ are exceedingly numerous, and rival the Diplurida in extent of distribution; but, owing to the complex and puzzling nature of their relationships, it is not easy to deduce any satisfactory conclusions from their distribution.

They are referable to the following sections, which are arranged as nearly as possible according to their lines of descent, starting with the most primitive, *i. e.* the Nemesiæ, which have departed least from the Diplurid type.

1. Nemesiæ.—The genus *Nemesia* itself is abundant in the Mediterranean Region, and is met with also in China; *Anemesia* occurs in Afghanistan, *Nemesiellus* in S. India, and *Scalidognathus* in Ceylon. *Hermacha*, *Hermachastes*, *Lepthereus*, *Pionothele*, and *Spiroctenus* inhabit S. Africa; *Genysa*, Madagascar; *Arbanitis*, Australia, Tasmania, and New Zealand; *Cantuaria*, New Zealand; *Rhachias*, *Carteria*, and *Hermacha* (the last also in S. Africa) in South and Central America.

2. Cyrtauchenii, differing from Nemesiæ in the procurvature of the fovea.—*Atmetochilus* and *Damarchus* occur in Burma and Sumatra; *Cyrtauchenius* and *Amblyocarenum* in the Mediterranean, the latter also in California; *Pelmatorycter* in E. and S.

Africa; *Microbatesia* in tropical W. Africa; *Stictogaster*, *Bessia*, and *Homostola* in S. Africa; *Stenoterommata*, *Pselligmus*, *Neocteniza*, *Eucteniza*, and *Enrico* in South and Central America; *Aptostichus* and *Actinoxia* in California; and *Myrmeciaphila* in Virginia and Carolina.

3. Aganippæ, differing from the preceding in the specialised arrangement of the eyes.—*Aganippe*, *Blakistonia*, *Anidiops*, *Idiosoma*—all confined to Australia.

4. Aporoptychi, differing from the Cyrtauchenii in the enlargement of the labium and maxillæ.—*Aporoptychus* and *Bolostromus* occur in tropical West Africa and South America; *Phrissœcia*, *Phœoclita*, *Celidotopus*, *Phœnothele*, and *Rhytidicolus* in S. America.

Of the above mentioned groups, that of the Nemesiæ is the only one that is represented at the present time in India, Madagascar, and New Zealand—a fact in keeping with its primitive status, and suggestive of an earlier migration into the Southern hemispheres. Singularly enough, the group is unrepresented in North America. This and the further facts that South Africa is the richest of the regions in number of genera, and that one of its genera, *Hermacha*, occurs also in Brazil, make it almost impossible to doubt that the group entered South America from South Africa. Again, since the group is also apparently absent from the whole of the area lying between India and Australia, we must look to South Africa, Madagascar, or South America as the source whence it entered Australia; and since the Mascarene genus *Genysa* is said to be nearly allied to the Australian *Arbanitis*, Madagascar and S. Africa were perhaps the feeders to the Australian area.

Since the Cyrtauchenii are specialised allies of the Nemesiæ, and therefore later developed forms, it is interesting to note their apparent absence from Madagascar, India, Australia, and New Zealand, which indicates a later southern migration from the north. The following hypothesis seems to explain the facts of their distribution. In early Tertiary times the group was continuously distributed throughout Europe, Asia, and North America. In Eastern Asia it descended a short distance into Indo-Malaya after the severance of Australia, and penetrated Africa after the formation of the Mozambique Channel. Similarly from the Sonoran Region it passed into Central and South America, after the Pliocene union of the latter with North America. Whether any of the South-American fauna was derived from Africa or *vice versâ*, there is no reliable evidence to show.

If the Aganippæ entered Australia from South-eastern Asia, it is strange that no related forms have been discovered in Austro-Malaysia. They may have come from South America or South Africa; but I am disposed to think that they have had an origin independent of the Cyrtauchenii in Australia from the Nemesiæ, from which they differ practically only in the procurvature of the fovea—a feature which is known to have arisen more than once

within the limits of the Mygalomorphæ. This conclusion as to their descent is supported by the fact that the specialised arrangement of the eyes is foreshadowed in *Dyarcyops*, one of the Nemesiæ, and by the presence of a single row of ungual pectinations in the Aganippæ and all the Australian Nemesiæ, two such rows being characteristic at least of the southern forms of the Cyrtauchenii.

The Aporoptychi are specialised Cyrtauchenii. Their distribution suggests that they originated in South America or South Africa, and crossed from the one continent to the other when the two were united. This conclusion is strongly supported by the occurrence of two of the genera in both of the areas in question.

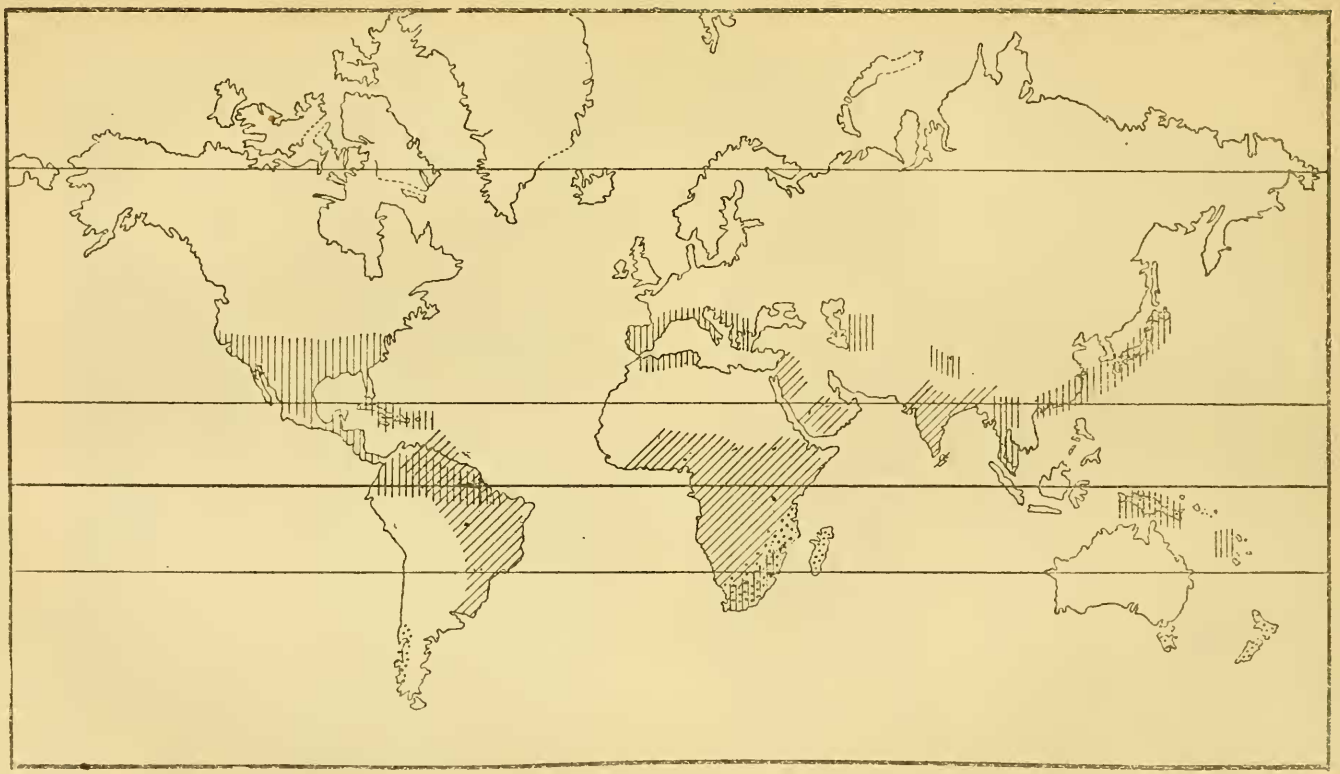
Family Ctenizidæ.

The genera of the subfamily Ctenizinæ are almost exclusively northern. *Cteniza*, *Æpycephalus*, and *Cyrtocarenum* are restricted to the Mediterranean; *Sterrhochrotus* occurs in Turkestan; *Latouchia* in China and the Himalayas; *Pachylomerus* in Spain, Algeria, Japan, N., Central, and S. America, and the West Indies; *Bothriocyrtum* in California; *Conothele* ranges from Burma to the Solomon Islands. The only genus which is exclusively southern is *Stasimopus*, which is confined to S. Africa.

The structural features of this group suggest that it is a specialised offshoot from some northern forms of the Cyrtaucheniidæ. This conclusion is borne out by the more restricted distribution of the genera, which, in virtue of their later appearance in the Northern hemisphere, have had less time to distribute themselves over the southern continents. The only genus which has entered the Ethiopian Region, namely *Stasimopus*, appears to have done so not earlier than the Pliocene, since it is seemingly not represented in Madagascar. *Conothele*, too, seems to have migrated southwards by way of Burma to the Solomon Islands, after the separation of Australia; *Pachylomerus*, the only form which enters the Neotropical Region, appears almost certainly to be a northern immigrant from the Sonoran region.

The Idiopine section, apparently a specialised offshoot of the Ctenizinæ, has, on the contrary, a more southern distribution than the typical Ctenizinæ. The genus *Idiops* (*Acanthodon*) itself has representatives in Central Asia, Syria, Arabia, India and Burma, Tropical and South Africa, and S. America; *Heligmomerus* occurs in India, Ceylon, and Tropical Africa; *Gorgyrella* in S. Africa; while the aberrant *Pseudidiops* is confined to the forests of South America.

The presence of the genus *Idiops* so far north as Central Asia and Syria, and in India, Burma, Tropical and Southern Africa, and Brazil, attesting as it does considerable powers of adaptation to varied climatic and other physical conditions, justifies the supposition that the genus never formed part of the Sonoran fauna of America. Otherwise it would be difficult to account for



Map to illustrate the Geographical Distribution of the *Ctenizidæ* and *Migidæ*.

Ctenizinæ. *Idiopinæ.* *Migidæ.*

its absence at the present time from this region, as well as from the West Indies and Central America. These considerations justify the view that South America acquired this element in its fauna, not from North America but from Africa. But by whatever route *Idiops* reached South America, it is probable that *Pseudidiops*, a specialised offshoot of that genus, arose within the Neotropical Region.

Family Halonoproctidæ.

The three known genera of this family, a specialised offshoot of the Ctenizidæ, namely, *Halonoproctus* from China, *Chorizops* and *Cyclocosmia* from the Sonoran Region, also constitute a northern group, which has not migrated into the southern continents.

Family Actinopodidæ.

Of the two genera of this family, *Eriodon* (*Missulena*) is restricted to Australia, and *Actinopus* to the Neotropical Region.

The descent of this family is doubtful, but its structure and distribution suggest its origin in the Southern hemisphere from the Cyrtaucheniidæ of the group Aporoptychi, which exist in South America and South Africa. Its present distribution may be accounted for on the hypothesis of the migration of the ancestral form either from Africa to Australia and thence to South America, or the other way about.

Family Migidæ.

The Migidæ are essentially a southern group. Two or three genera (*Myrtale* and *Thyropœus*) occur in Madagascar; *Moggridgea* in Sokotra, Nyasaland, Natal, and Cape Colony; *Heteromigas* in Tasmania; *Migas*, nearly related to *Moggridgea*, in New Zealand; and an undescribed genus, close to *Heteromigas*, in Chili.

The recurvature of the thoracic fovea in this family suggests its descent from Cyrtaucheniidæ of the section Nemesiæ, an ancient and very widely distributed group, with representatives in South Africa, Madagascar, South America, Australia, and New Zealand, the countries to which the Migidæ are now restricted. The distribution of the latter attests not only a southern origin, perhaps in the Afro-Mascarene area, but also migration thence to Australia and New Zealand, and from Australia to South America.

Family Barychelidæ.

The genera of this family fall into three sections, which may be arranged in order of specialisation as follows:—

a. Barycheli: *Leptopelma*, Mediterranean Region; *Atrophothele*, Sokotra; *Eubrachythele*, Somaliland; *Cyphonisia*, W. Africa; *Pisenor*, E. Africa; *Brachionopus*, Cape Colony; *Tigidia*,

Mauritius; *Sasonichus*, S. India; *Sipalolasma* and *Plagiobothrus*, Ceylon; *Encyocrypta*, Singapore to Australia; *Barychelus*, New Caledonia; *Idioctis*, Upolu; *Idiommata* and *Trittame*, Australia; *Psalistops*, *Stothis*, *Euthycælus*, *Epipedesis*, *Cosmopelma*, *Trichopelma*, *? Acanthogonatus*, *Homœoplacis*, *Idiophthalma*, *Strophœus*, *Cyrtogrammomma*, Neotropical Region.

b. Diplothelæ: *Diplothele*, India and Ceylon; *Forsythula*, Madagascar.

c. Sasones: *Sason*, Seychelles, Maldives, Ceylon, India, and Celebes; *? Rianus*, Pinang.

The existence of a primitive type, *Leptopelma*, in the Mediterranean area, and the entire absence of the group from the Sonoran Region and from China, suggest its origin in the western part of the Old World. Moreover, the presence of genera in Sokotra, Mauritius, Madagascar, and all over the Ethiopian Region attests a southern migration at a very early date. Similarly, the extension of the group over the Oriental Region, from India to Australia, suggests a perhaps contemporaneous movement in a south-easterly direction over the area in question, after the isolation of New Zealand. Again, the absence of genera of this family from the Sonoran Region, coupled with the relationship between the Mediterranean genus *Leptopelma* and many of the Neotropical types on the one hand, and between the remainder of the latter and the Tropical African genera on the other, points to a transatlantic connection between Africa and Europe and South America. At the same time, the possibility of a migration into South America from Australia across the area of the Pacific must be borne in mind.

In the absence of evidence to the contrary, the genus *Sason*, specialised both in structure and habits, may be regarded as having arisen from a primitive type in the area it at present occupies. That this must have taken place in very early times, before the severance of the Seychelles from India and Ceylon, would be an unavoidable conclusion, were we sure of the distinctness of the Seychellesian from the Ceylonese species. But the occurrence of one of the Ceylonese species in the Maldives proves, I think, artificial introduction into that Archipelago; and the same explanation may apply to the presence of the genus in the Seychelles.

One other point of interest remains, and that is the unquestionably close relationship that obtains between the Indian and Ceylonese genus *Diplothele* and the Mascarene *Forsythula*, the latter being a more specialised type. This is almost the only undoubted case of similarity between the faunas of Madagascar and India that the Mygalomorphæ supply.

Family Aviculariidæ.

The distribution of this family is most instructive.

The heterogeneous group of genera associated together as

Avicularinæ is represented in the Mediterranean area by the primitive genus *Ischnocolus*, which ranges from Spain and Algeria to Syria, and perhaps also occurs in Burma; by *Chætopelma* and *Cratorrhagus*, which are perhaps identical, found in the eastern countries of this sea; in India by the genera *Phlogiodes*, *Plesiophrictus*, and *Heterophrictus*; and in tropical West Africa by *Scodra*, *Heteroscodra*, *Selenogyrus*, *Heterothele*, and *Solenothele*. In America the group is represented by a wealth of genera ranging from the Southern States of the Union (Sonoran), throughout the West Indies and over the whole of S. America to Chili and the Argentine. It is necessary to mention only a few of the principal genera, such as *Aphonopelma* from the Sonoran, *Brachypelma*, *Cyrtopholis*, *Hapalopus*, *Acanthoscurria*, *Lasiodora*, *Pamphobeteus*, *Avicularia*, *Tapinauchenius*, *Citharoscelus*, *Metriopelma*, *Theraphosia*, &c. &c.

The Selenocosmiinæ range from India and Ceylon over the Indo- and Austro-Malayan Islands and Australia; the principal genera being *Pœcilotheria*, confined to India and Ceylon; *Chilobrachys*, occurring in India, Ceylon, and Burma; *Lyrognathus* in Assam; *Selenocosmia*, extending from the Himalayas into Australia; and *Selenotypus* and *Selenotholus*, which are confined to Australia.

The Thrigmopœinæ, represented by *Thrigmopœus* and *Haploclastus*, are confined to S. India.

The Ornithoctoninæ—*Cyriopagopus*, *Melopœus*, *Ornithoctonus*, *Phormingochilus*, *Citharognathus*—extend from Burma to the Moluccas.

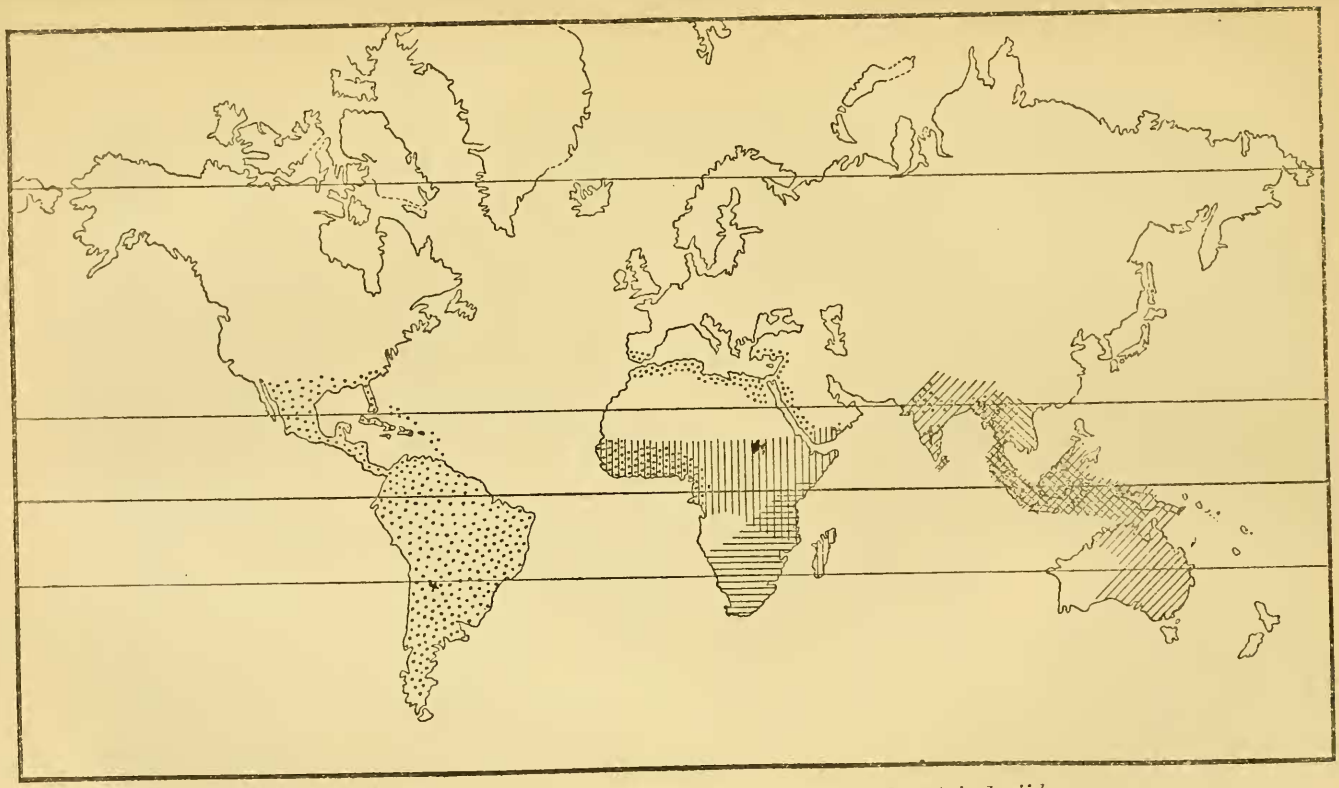
The Eumenophorinæ, containing the genera *Eumenophorus* from Sierra Leone, *Hysterocrates* from the Congo, &c., *Phoneyusa* and *Pelinobius* from the Congo and Masailand, *Batesiella* from the Camaroons, *Citharischius* and *Anoploscelus* from British East Africa, *Monocentropus* from Sokotra and S. Arabia, and *Encyocrates* from Madagascar, are thus restricted to Madagascar and the northern portions of the Ethiopian Region, since they do not appear to pass south of the Congo or the Zambesi.

The Harpactirinæ, on the contrary, are confined to South and East Africa, ranging from Masailand to Cape Colony, and crossing the area of the Eumenophorinæ north of the Zambesi. The principal genera are *Pterinochilus*, *Eucratoscelus*, *Ceratogyrus*, *Cœlogenium*, *Harpactirella*, and *Harpactira*.

Of the above-mentioned subfamilies the least specialised is that of the Avicularinæ, which contains genera like *Heterothele* and *Mitothele*, serving to link in a measure the Avicularidæ with the Macrotheline Dipluridæ. It is, moreover, the most widely distributed and most northerly in its range of all the subfamilies, and far the richest and most diversified in its genera.

Certain facts point to the conclusion that the Selenocosmiinæ originated in South-eastern Asia. The two most primitive genera of the subfamily, *Phlogiellus* and *Selenocosmia*, occur at the

Text-fig. 61.



Map to illustrate the Geographical Distribution of the *Avicularidæ*.

Aviculariinæ. *Eumenophorinæ.* *Harpactirinæ.* *Selenocosmiinæ.* *Ornithoctoninæ.* *Thrigmopœinæ.*

present time in this area, the former in Java and the Nicobars, the latter all over the Indo- and Austro-Malayan Islands and Australia. *Selenocosmia*, which must be regarded as a direct descendant of *Phlogiellus*, must itself be looked upon as the ancestor of the Malayan *Coremiocnemis*, the Assamese *Lyrognathus*, the Burmese, Indian, and Ceylonese *Chilobrachys*, and of the two Australian genera *Selenotypus* and *Selenotholus*, all of which, in the absence of evidence to the contrary, may be held to have originated within the areas of their present distribution. The affinities of the aberrant genus, *Pœcilotheria*, which is specialised both in structure and habits, are more doubtful; but there is no evidence against the hypothesis that it has been evolved in India itself.

The presence of *Pœcilotheria* and *Chilobrachys* in Ceylon and India attests their occupation of the latter area before the severance of Ceylon; and the extension of *Selenocosmia* into Australia but not into New Zealand, similarly attests a southern migration into the former country before its separation from South-eastern Asia, but after the isolation of New Zealand. It seems probable, indeed, that this southern immigration into Australia synchronised with that of the ancestors of the Australian marsupial mammals, and in this connection it is significant to note that the latter are believed to have originated in South-eastern Asia[1] and to have entered Australia in Eocene times. The great difference, however, in distribution between the Marsupials and Selenocosmiinæ may be explained by the survival of the latter, and the extinction of the former, in the area of their birth.

The Thrigmopœinæ, which are confined, so far as is known, to India, appear to have been developed from the Avicullariine stock at a late date, namely after the depression of the connecting land with Ceylon; and the Ornithoctoninæ, which range from Siam and Burma to the Moluccas, seem similarly to have put in an appearance after the separation of Australia from the continent to the north of it.

The Eumenophorinæ must have entered or been developed in the Ethiopian Region at an early date, antecedent to the separation of South Arabia and Sokotra from what is now Somaliland, and before the formation of the Mozambique Channel divided Madagascar from East Africa.

The Harpactirinæ, on the contrary, which range from Somaliland to Cape Colony but are unknown in Madagascar, seem to have originated independently within the Ethiopian Region subsequent to the Miocene period. The least specialised of the genera (*Harpactirella* and *Pterinochilus*) have not departed far from the type of structure found in the Avicullariinæ.

There remains the South-American fauna to be accounted for.

Owing to the general similarity that obtains between the genera of this area and those of other parts of the world, the

[1] Lydekker, 'Geogr. Hist. Mammals,' p. 55 (1896).

differences in extremest cases being merely accorded subfamily rank and in others only generic rank, it is hard to believe that the ancestors of the existing fauna entered South America from North America in the early part of the Secondary Period, that is to say in pre-Jurassic times, and that they have been isolated since that date until the close of the Miocene. Again, if it be supposed that they passed southwards from the north after the union of the two Americas with the close of the Miocene, the conclusion is inevitable either that the wealth of genera now existing in South America has been evolved since that date, or that there has been such a wholesale destruction of genera in the north as to leave but one genus (*Aphonopelma*) in the Southern States of N. America at the present day [1].

The occurrence of this genus in the area in question may be equally well attributed to migration of its ancestors northwards into the Sonoran Region after the union of North and South America at the close of the Miocene.

Again, since no members of the Avicularinæ occur at the present time in Australia or Austro-Malaysia, it is needless to look to this area as the source of the South-American fauna of this subfamily.

Africa, therefore, and the Mediterranean area alone remain as the centres whence the incursion could have taken place. In support of the view that preference in this connection should be given to Tropical Africa may be urged the following facts. The Avicularinæ of this region are confined to the forest-region of West Africa, which is roughly conterminous with the basin of the Congo and includes also the forest-covered district to the north of the Gulf of Guinea, and are unknown in South Africa. Secondly, the West-African genus *Scodra* is apparently the nearest living ally of the Brazilian genus *Avicularia*; and *Heterothele* and *Solenothele*, from the same region as *Scodra*, are equally nearly related, especially the former, to the Patagonian *Mitothele*.

Perhaps also some significance must be attached to the circumstance that the stridulating-organ which attains such a state of perfection in the Eumenophorinæ is represented in an imperfect and unspecialised state in many of the South-American genera of Avicularinæ.

Summary of the preceding pages.

In very early Tertiary times, or, perhaps, still earlier, the primitive Macrotheline Dipluridæ arose in Eastern Asia and spread thence in four directions:—(1) South-eastwards into Australia and New

[1] Three other genera, namely *Rhechostica*, *Tapinauchenius*, and *Avicularia*, have been recorded from the Southern States of North America; the first from Texas, the second from Texas also and 'Indian Territory,' and the third from California. The generic affinities of the first are doubtful; it may indeed be referable to *Aphonopelma*. The records of the second and third have little value, since the specimens determined were immature females.

Zealand, where the most primitive type of all, *Hexathele*, still survives and whence the ancestor of its near ally, *Scotinœcus*, crossed to South America. (2) South-westwards into India, Madagascar, and Tropical Africa (*Ischnothele* and *Evagrus*), whence these genera migrated into South America, passing thence into North America in later Tertiary times. (3) North-westwards into the Mediterranean Region (*Phyxioschœma* and *Macrothele*). (4) North-eastwards into North America, to give rise to the Mecicobothriidæ.

On the other hand, the genera of Diplurinæ, which are more specialised than the Macrothelinæ, and therefore of later origin, were represented in Tertiary times by genera (*Brachythele*) both in the Sonoran and Mediterranean Regions. From the latter, perhaps in the Oligocene era, they descended into Africa and Madagascar, but do not appear to have entered the Oriental Region at all. From Africa and Madagascar they probably entered South America, and perhaps Australia also, though they may equally well have passed from South America to Australia. In later Tertiary times also it is probable that there was a commingling of Sonoran and Neotropical forms due to southward and northward migration.

The Mecicobothriidæ, which arose in the Sonoran Region from a form, like *Hexura*, allied to *Hexathele*, themselves gave rise in early Tertiary times to the Brachybothriidæ, which still exist there and have succeeded in reaching Japan (*Acattyma*), and to the Atypidæ as well, which also crossed into Eastern Asia, and thence extended westwards as far as Ireland and Algeria, and southwards into Burma and Java. In South-eastern Asia from a primitive Atypoid genus originated *Calommata*, which probably in the Pliocene extended right away from the Oriental Region into West Africa, the existing species being known only from the latter area and from Indo-Malaysia and Japan.

In later Tertiary times the Sonoran Mecicobothriidæ moved southwards into South America, where the existing genus *Mecicobothrium* met the genus *Scotinœcus*, the ancestors of which, according to my hypothesis, reached the same country by the southern route from New Zealand.

The Cyrtaucheniidæ of the primitive group Nemesiæ at an early date entered India, Africa, and Madagascar from the north, or equally likely originated in Africa itself and spread thence into the Mediterranean Region, into Madagascar and India, into South America and into the Australian Region, as is attested by the closeness of the similarity between the South-African, South-American, and Australian species, and the absence of the group from the eastern parts of the Oriental and from the Sonoran Regions. Within Australia itself they seem to have given rise to the group Aganippæ.

The explanation given above of the distribution of the Diplurine Diplurida applies in almost every particular to that of the Cyrtaucheniidæ of the Cyrtaucheni group, except that the latter were later in the southward movement into Africa, reaching

that region after the separation of Madagascar, and except that they have left isolated genera in Indo-Malaya. The Aporoptychi arose in Africa from the Cyrtauchenii before the severance of that country from South America.

The Actinopodidæ were perhaps evolved from an *Aporoptychus*-like form in South America, and crossed thence to Australia.

The Migidæ probably originated in the Ethiopian Region before the isolation of Sokotra and Madagascar. The similarity between the South-African and Novo-Zelandian, the Tasmanian and Patagonian genera suggests that the migration of the family from its hypothetical home took an eastward direction.

The Ctenizidæ, a specialised northern offshoot from the Cyrtauchenii, crossed during the Tertiary period from Asia to North America, and occur at the present time in the Sonoran and Mediterranean Regions. It entered South-eastern Asia after the separation of Australia; and Africa after the formation of the Mozambique Channel, but before the sinking of the connecting land with South America. In late Tertiary times the union of North and South America admitted the Sonoran and Mediterranean genus *Pachylomerus* into the Neotropical area, where it mingled with the Idiopine element that had come from Africa.

The Halonoproctidæ must similarly have crossed from America to Asia, or *vice versa*, during the Tertiary Period, since the existing genera persist at the present time in the Sonoran Region and China.

It is impossible to determine the original home of the Barychelidæ. Possibly the family originated at an early date in Africa, and became distributed all over the area they now inhabit from that centre. Possibly it arose in the northern parts of the Old World, and at an early date extended southwards into the Ethiopian, Oriental, and Australian Regions. However that may be, there seems no reason to think that the group entered the Neotropical Region from the Sonoran.

The Aviculariidæ arose in the northern portion of the Old World, whence emigrants passed into the Oriental and Ethiopian Regions. From one primitive type in India sprang the Thrigmopœinæ; from another in Indo-Malaysia the Ornithoctoninæ; and from a third the Selenocosmiinæ, which distributed themselves from India, Ceylon, and the Philippine Islands into Australia, perhaps in Eocene times. In the Ethiopian Region, from a primitive type arose the Eumenophorinæ, at a sufficiently early date to reach Sokotra, S. Arabia, and Madagascar. Later on, after the severance of Madagascar, arose the Harpactirinæ. The genera of these specialised subfamilies probably supplanted to a large extent both in the Ethiopian and Oriental Regions the Aviculariinæ, but the latter attained an enormous development in South America, which they seem to have reached from Africa or possibly from Europe. With the Pliocene union of North and South America certain forms spread northwards from South America into the Sonoran Region.

Part III.

Geographical Regions and their Principal Genera.

Mediterranean Region.

Diplurida.

Diplurinæ.—*Brachythele*: Greece, Cyprus, Central Asia.

Macrothelinæ.—*Macrothele*: Spain, China, Loo Choo. *Phyxioschæma*: Transcaspia.

Brachybothriidæ.—*Acattyma*: Japan.

Atypidæ.—*Atypus*: South and Central Europe, Algeria, Japan. *Calommata*: Japan.

Cyrtaucheniidæ.—*Nemesia*: S. Europe, N. Africa, China. *Anemesia*: Afghanistan. *Cyrtauchenius*: Southern countries of Mediterranean. *Amblyocarenum*: S. Europe, N. Africa.

Ctenizidæ.—*Pachylomerus*: Spain, Algeria, Japan. *Idiops*: Syria. *Cteniza*: France, Italy. *Ægpycephalus*: Sicily, Sardinia. *Cyrtocarenum*: Eastern countries of Mediterranean. *Sterrhochrotus*: Turkestan. *Latouchia*: Loo Choo Islands, China.

Halonoproctidæ.—*Halonoproctus*: China.

Barychelidæ.—*Leptopelma*: S. Italy, N. Africa.

Aviculariidæ.

Aviculariinæ.—*Ischnocolus*: S. Europe, N. Africa. *Cratorrhagus* and *Chætopelma*: Eastern area of Mediterranean.

Of the above-mentioned genera, 22 in number, those belonging to the Aviculariidæ and Barychelidæ are peculiar; also *Sterrhochrotus*, *Cyrtocarenum*, *Ægpycephalus*, and *Cteniza* amongst the Ctenizidæ; *Cyrtauchenius*, *Anemesia*, and *Nemesia* amongst the Cyrtaucheniidæ; *Phyxioschæma* amongst the Diplurida; and perhaps *Acattyma* amongst the Brachybothriidæ. Of the others, *Brachythele* and *Amblyocarenum* are also Sonoran; *Macrothele* and *Latouchia* also Oriental; *Atypus*, Oriental and Sonoran; *Calommata*, Oriental and Ethiopian; *Pachylomerus*, Sonoran and Neotropical; *Idiops*, Oriental, Ethiopian, and Neotropical.

Thus of the 22 genera enumerated, more than half, namely 12, are peculiar. Of the rest, 4 are Sonoran and 5 Oriental, the latter, with exception of *Idiops*, occurring in the Indo-Chinese area; 2 Ethiopian and 2 Neotropical. With the Australian Region the Mediterranean has no genera in common, although *Porrhothele* and *Stenygrocercus* of the former are nearly related to *Macrothele* and *Phyxioschæma* of the latter. These data make it impossible to attach the Mediterranean area to either of the others with which it has genera in common. Hence it must be regarded as a Region apart. The only genus which extends into the Holarctic is *Atypus*.

It may be defined as the Region lying north of the Ethiopian and Oriental Regions, and south of the great mountain-chains of Europe, north of which the Mygalomorphæ, excepting *Atypus*, do not pass.

Ethiopian Region.

(Africa south of the Sahara, South Arabia (Sokotra), and Madagascar.)

Diplurida.

Diplurinæ.—*Hapalothele*: Madagascar. *Brachytheliscus*: S. Africa. } Perhaps the same.

Macrothelinæ.—*Evagrus*: S. Africa. *Ischnothele*: Madagascar, S. & W. Africa.

Atypidæ.—*Calommata*: W. Africa.

Cyrtaucheniidæ.—*Hermacha*, *Hermachastes*, *Lepthereus*, *Pionothele*, and *Spiroctenus*: S. Africa. *Genysa*: Madagascar. *Pelmatorycter*: S. Africa. *Microbatesia*: W. Africa. *Bessia*, *Stictogaster*, and *Homostola*: S. Africa. *Aporoptychus* and *Ancylotrypa*: W. Africa.

Ctenizidæ.—*Stasimopus*: S. Africa. *Idiops*: E., W., & S. Africa. *Heligmomerus*: E. & S. Africa. *Gorgyrella*: S. Africa.

Migidæ.—*Moggridgea*: S. Africa, Sokotra. *Myrtale* and *Thyropœus*: Madagascar.

Barychelidæ.—*Atrophothele*: Sokotra. *Eubrachythele*, *Pisenor*, and *Pisenorodes*: E. Africa. *Cyphonisia*: W. Africa. *Brachionopus*: S. Africa. *Forsythula*: Madagascar. *Tigidia*: Mauritius. *Sason*: Seychelles.

Avicularidæ.

Aviculariinæ.—*Scodra*, *Heteroscodra*, and *Selenogyrus*: W. Africa. *Heterothele*: W. & E. Africa. *Solenothele*: W. Africa.

Eumenophorinæ.—*Hysterocrates*: W. Africa. *Loxomphalia*: E. Africa. *Phoneyusa* and *Pelinobius*: W. & E. Africa (probably identical). *Citharischius*: E. Africa. *Batesiella*: W. Africa. *Anoploscelus*: E. Africa. *Monocentropus*: Sokotra, S. Arabia. *Encyocrates*: Madagascar.

Harpactirinæ.—*Pterinochilus*: E. & S. Africa. *Eucratoscelus*: E. Africa. *Ceratogyrus*, *Cœlogenium*, *Harpactirella*, and *Harpactira*: S. Africa.

Of the 54 above-mentioned genera, all are peculiar to the Region, with exception of *Evagrus*, *Ischnothele*, *Idiops*, and *Hermacha*, which also occur in South America; *Sason*, *Idiops*, *Ischnothele*, and *Calommata* in the Oriental Region; possibly also with the exception of *Ancylotrypa* and *Moggridgea*, if the former is identical with the South-American *Bolostromus*, and the latter with the New-Zealand *Migas*.

Apart from its distinctive genera, the Region is essentially characterised by the two subfamilies of Avicularidæ, the Eumenophorinæ and Harpactirinæ, which are peculiar.

The fauna of Madagascar does not seem to warrant the ascription of more than subregional importance to this island. Apart from the occurrence of *Ischnothele* in India and Madagascar, and the relationship between *Diplothele* and *Forsythula*,

Madagascar shows no similarity to the Oriental Region, with which Simon united it. (Trouessart, La Géogr. Zoolog. pp. 208–211, 1890.)

The African portion of the Ethiopian Region is divisible into two well-marked subregions, namely, the West-African or forest area of the Congo, which extends from the shores of the Gulf of Guinea to Uganda, and a South and East-African area. The former is essentially characterised by the presence of the Avicullariinæ, Eumenophorinæ, and Barychelidæ; the latter by the Harpactirinæ, Cyrtaucheniidæ, and Migidæ. In East Africa, north of the Zambesi, the two regions cross.

Oriental Region.

Diplurida.

Macrothelinæ.—*Macrothele*: Burma, Malacca, Java. *Ischnothele*: India.

Atypidæ.—*Atypus*: Burma, Java. *Calommata*: Burma, Siam, Java, Sumatra.

Cyrtaucheniidæ.—*Nemesiellus*: S. India. *Scalidognathus*: Ceylon. *Damarchus*: Burma, Malacca. *Atmetochilus*: Tenasserim.

Ctenizidæ.—*Idiops*: India, Burma. *Heligmomerus*: Ceylon, S. India. *Latouchia*: Himalayas. *Conothele*: Burma to Solomon Islands.

Barychelidæ.—*Diplothele*: India, Ceylon. *Sasonichus*: India (Travancore). *Plagiobothrus* and *Sipalolasma*: Ceylon. *Sason*: India, Ceylon, Saleyer. *Encyocrypta*: Malacca, Borneo, to Queensland.

Avicullariidæ.

Avicullariinæ.—*Phlogiodes* and *Heterophrictus*: India. *Plesiophrictus*: India, Ceylon, ? Burma. *Acolischnus* [1]: Burma.

Thrigmopœinæ.—*Thrigmopœus* and *Haploclastus*: Western and Southern India.

Selenocosmiinæ.—*Pœcilotheria*: India, Ceylon. *Chilobrachys*: India, Ceylon, Burma. *Selenocosmia*: Himalayas, Burma, Java, Sumatra, Borneo, New Guinea. *Phlogiellus*: Java, Nicobars. *Lyrognathus*: India (Assam). *Coremiocnemis*: Malacca. ? *Orphnœcus*: Philippine Islands.

Ornithoctoninæ.—*Ornithoctonus*: Burma. *Cyriopagopus*: Burma, Malacca. *Melopœus*: Burma, Siam. *Citharognathus*: Borneo. *Phormingochilus*: Borneo, Celebes, Moluccas.

36 genera. Characteristic of this Region, and entirely confined

[1] New name for the species from Tenasserim, described by Thorell as *Ischnocolus brevipes* (Thorell, Ann. Mus. Genova, xxxvii. p. 170, 1897; also Pocock, 'Fauna of British India: Arachnida,' p. 183), which at least differs from the typical species of *Ischnocolus* from the Mediterranean in having the tarsus of the palp short in the male.

to it, are the two subfamilies of Avicularidæ, Thrigmopœinæ and Ornithoctoninæ, while the third subfamily, Selenocosmiinæ, is common to it and the Australian Region. Moreover, all the genera of Aviculariinæ, of Cyrtaucheniidæ and Barychelidæ are peculiar, with the exception of *Encyocrypta*, belonging to the last-mentioned, which extends to Australia. *Conothele* amongst the Ctenizidæ is also peculiar, if the Solomon Islands be included. For the rest, *Macrothele* and *Atypus* occur also in the Mediterranean Region; *Calommata* in Japan and West Africa; *Ischnothele* in Madagascar, Africa, and South America; *Idiops* in Africa and South America; *Heligmomerus* in Africa; *Latouchia* in China; and *Sason* in the Seychelles.

The apparent richness of India, Ceylon, and Burma, as compared with the eastern portion of the Region, may be merely due to more extensive collecting in the former countries; or it may be attributable to failure to penetrate far into the latter before the break-up of the area into islands. Four genera only are known to cross Wallace's line, namely, *Selenocosmia*, *Phormingochilus*, *Encyocrypta*, and *Sason*; but, apart from these genera, there is no evidence to show that this channel constitutes the divisional line between the Oriental and Australian Regions.

Australian Region.

(Australia and its adjacent Islands.)

Dipluridæ.

Macrothelinæ.—*Stenygrocercus*: N. Caledonia, Queensland. *Porrhothele* and *Hexathele*: New Zealand. *Atrax* and *Hadronyche*: Australia.

Diplurinæ.—*Aname*, *Ixamatus*, *Chenistonia*, and *Dekana*: Australia, Tasmania.

Cyrtaucheniidæ.—*Cantuaria*: New Zealand. *Arbanitis*: New Zealand, Australia. *Dyarcyops*, *Aganippe*, *Blakistonia*, *Anidiops*, and *Idiosoma*: Australia.

Migidæ.—*Heteromigas*: Tasmania. *Migas*: New Zealand.

Actinopodidæ.—*Eriodon*: Australia.

Barychelidæ.—*Idiommata*: Australia. *Encyocrypta*: Australia, New Caledonia. *Trittame*: Australia. *Barychelus*: New Caledonia. *Idioctis*: Upolu.

Avicularidæ.

Selenocosmiinæ.—*Selenocosmia*, *Solenotholus*, and *Selenotypus*: Australia.

Of the above-mentioned 27 genera, all are peculiar to the Region with the exception of *Encyocrypta* and *Selenocosmia*, which also occur in the Oriental Region, and possibly of *Migas*, which may prove indistinguishable from the South-African *Moggridgea*.

The poverty of New Zealand in genera, and the distinctness of two of the three forms that do occur there, entitle it to subregional rank, but no more.

The Austro-Malayan Islands, which were referred by Wallace to the Australian Region, belong, according to their Arachnid fauna, to the Oriental Region—Wallace's line being practically non-existent.

Sonoran Region.

Dipluridæ.

Diplurinæ.—*Brachythele* : California, Texas, &c.

Macrothelinæ.—*Evagrus* : Idaho.

Mecicobothriidæ.—*Hexura* : Oregon and Washington State.

Brachybothriidæ.—*Brachybothrium* : From Texas and Virginia to British Columbia. *Atypoides* : California.

Atypidæ.—*Atypus* : Eastern States, from Wisconsin to Florida.

Cyrtaucheniidæ.—*Amblyocarenum*, *Aptostichus*, and *Actinoxia* : California. *Myrmeciaphila* : Carolina, Virginia.

Ctenizidæ.—*Pachylomerus* : Carolina, Alabama, &c., Mexico. *Bothriocyrtum* : California, Utah, Texas, Mexico.

Halonoproctidæ.—*Cyclocosmia* : California, Alabama. *Chorizops* : Mexico.

Avicularidæ.

Aviculariinæ.—*Aphonopelma* : Texas, Arizona, California. And perhaps others.

Out of the above-given list of 15 genera no fewer than 10 are peculiar to the Region, all, that is to say, with the exception of *Atypus*, *Brachythele*, *Amblyocarenum*, and *Pachylomerus*, which are also present in the Mediterranean Region, and *Evagrus*, which is met with in the Neotropical and Ethiopian Regions.

This Region, including the Mexican plateau and the Southern States of the Union, extends northwards to the northern limits of the Mygalomorphæ, or at least to those of the Scorpiones and Solifugæ [1].

Neotropical Region.

(Central America south of the Mexican plateau, West Indies, Bahamas, and South America.)

The principal genera are:—

Dipluridæ.

Diplurinæ.—*Diplura* : S. America. *Uruchus* : Ecuador. *Trechona*, *Melodeus*, and *Harmonicon* : Brazil. *Fufius* : Central and South America. *Trissothele* : Chili. *Lycinus* : Argentine.

Macrothelinæ.—*Ischnothele* : Central and South America, W. Indies. *Evagrus* : Central America.

Paratropidæ.—*Paratropis* : Ecuador, Amazons. *Anisaspoides* : Amazons. *Anisaspis* : W. Indies.

Mecicobothriidæ.—*Mecicobothrium* : Argentine.

[1] Compare also in this connection the distribution on the coast of *Limulus polyphemus*, from Cape Cod to the Gulf of Mexico.

Cyrtaucheniidæ.—*Stenoterommata*: Brazil, Chili. *Pselligmus*: Brazil. *Eutychides*: Central America, Antilles. *Aporoptychus* and *Bolostromus*: S. America. *Rhytidicolus*: Venezuela. *Phrissæcia*: Ecuador. *Phæoclita* and *Celidotopus*: Venezuela. *Hermacha*: Brazil, Chili. *Carteria*: Chili. *Rhachias*: Brazil. *Neocteniza*: Central and South America. *Eucteniza* and *Enrico*: Central America.

Actinopodidæ.—*Actinopus*: Central America to the Argentine.

Ctenizidæ.—*Pachylomerus*: Central and South America, W. Indies. *Idiops* and *Pseudidiops*: S. America.

Migidæ.—(Undescribed genus): Chili.

Barychelidæ.—*Psalistops*: Venezuela. *Stothis*: Venezuela, W. Indies. *Euthycælus* and *Epipedesis*: Venezuela. *Cosmopelma*: Brazil. *Trichopelma*: St. Domingo, Brazil. *Idiophthalma*: Brazil. *Cyrtogrammomma*: Demerara. *Homœoplacis*: Brazil.

Aviculariidæ.

Aviculariinæ.—*Mitothele*: Patagonia. *Thalerommata* and *Tmesiphantes*: Brazil. *Dryptopelma*: Ecuador. *Magulla*: Brazil. *Adranochelia* and *Chætorrhombus*: Venezuela. *Stichoplastus*: Venezuela, Trinidad. *Hapalopus*: Central and South America. *Metriopelma*: Central America to Argentine. *Cyrtopholis*: W. Indies, Bahamas, Central America. *Citharacanthus* and *Brachypelma*: Central America. *Homœomma*: Southern Brazil. *Paraphysa* and *Phryxotrichus*: Chili. *Citharoscelus*: Chili, Argentine, Brazil. *Lasiodora*: S. Brazil. *Pamphobeteus*: Ecuador, Colombia. *Phormictopus*: Hayti. *Acanthoscurria*: W. Indies to Argentine. *Sericopelma*: Panama, Cayenne. *Ephebopus*: Amazons. *Aricularia*: Brazil, W. Indies, Central America. *Tapinauchenius*: Central and South America. *Psalmopœus*: S. America.

This list of 69 genera, although incomplete, shows the Neotropical Region to be far the richest of all in point of numbers. Moreover, all are peculiar to the Region except *Pachylomerus*, which occurs also in the Sonoran and Mediterranean Regions; *Idiops*, which is also met with in Africa, India, and the Mediterranean Region; and *Hermacha*, *Aporoptychus*, possibly *Bolostromus*, *Evagrus*, and *Ischnothele*, which have been recorded from Africa, the last-named also from Madagascar and India. So too the family Paratropidæ is confined to the Region; the Mecicobothriidæ exist elsewhere only in the Sonoran Region; and the Actinopodidæ only in Australia.

Part IV.

Distribution of some of the Families of Arachnomorphæ that were represented in the Oligocene Period.

The only fossil Spiders, with one or two exceptions, of which the generic determination may be trusted, are those that have been found in the amber-beds of Oligocene age. Those that have been referred to genera not now known to exist have no special importance from a geographical standpoint; but of those that have been assigned to existing genera, the following may be taken as a fairly complete list:—*Segestria* and *Dysdera* (Dysderidæ); *Eresus* (Eresidæ); *Amaurobius* (Dictynidæ); *Aranea*, *Zilla*, *Tetragnatha*, and *Nephila* (Argiopidæ); *Archæa* (Archæidæ); *Tegenaria* and *Agelena* (Agelenidæ); *Drassus* (Drassidæ); *Clubiona*, *Anyphæna*, and *Sparassus* (Clubionidæ); *Thomisus* and *Philodromus* (Thomisidæ).

Although since the Oligocene these Spiders have had the same time for dispersal, they nevertheless differ greatly in their distribution. *Dysdera*, for example, is apparently indigenous only in the Mediterranean and central portions of Europe and Asia[1]; *Eresus* is found in South and Central Europe, Central Asia, China, and Africa to the north and south of the Sahara; *Amaurobius* all over the world with the exception of India, tropical Africa, and Madagascar; *Aranea* and *Tetragnatha* are cosmopolitan; *Nephila* is mainly restricted to the tropics and the Southern hemisphere, though in Eastern Asia it extends as far north as Japan, and in North America enters the Southern States of the Union; *Archæa* is known only from Madagascar; *Tegenaria* is indigenous apparently only in Europe and North America; *Agelena* in Europe, South Africa, India, and Burma; *Anyphæna* in North, Central, and South America (Andes), Japan, India (in the mountains), and Central Europe.

The Hersiliidæ were represented in the Oligocene of Europe. The four existing genera are distributed as follows:—*Hersilia* ranges from the southern area of the Mediterranean as far as Malaysia in the Oriental Region, and over Africa and Madagascar. Its very near ally *Murricia* is confined to India; *Hersiliola* is known only from the Mediterranean Region and S. Africa. *Tama*, next to *Hersiliola* the most primitive of all the genera, occurs in the Mediterranean, Oriental, Australian, and Neotropical Regions.

The distribution of the group offers no difficulties to the hypothesis of a southern migration from Europe. The absence of the genus *Tama* from North and Central America strongly suggests its existence in South America to be attributable to migration from Australia.

Two genera of Eresidæ have been recorded from the European

[1] Specimens that have been recorded from the Southern hemisphere are mostly, probably in all cases, referable to imported European species.

Oligocene. At the present time the family is represented by *Adonea* and *Dorceus* in the southern area of the Mediterranean; by *Dresserus* and *Seothyra* in Tropical and South Africa; by *Stegodyphus* in the Mediterranean Region, India, Ceylon, and Burma in the Oriental Region, and East and South Africa in the Ethiopian Region; by *Eresus*, which extends across Europe and Asia from England to China, being especially abundant in the Mediterranean Region and also occurs in South Africa. The absence of this group from Madagascar points to a late (probably Pliocene) incursion from the north into Africa, which, in conjunction with its failure to reach North America and Australia, also explains its absence from South America.

The only existing genus of Urocteidæ, *Uroctea*, was represented in the European Oligocene. At the present time it is found in the Mediterranean Region, China, Japan, India, and South Africa. The apparent absence of the genus from Madagascar indicates a late movement into South Africa.

The Palpimanidæ are also alleged to date back to the Oligocene. The most primitive member of the family, *Huttonia*, constituting the Huttoniinæ, is now restricted to New Zealand. The more specialised Stenochilinæ are confined to the Oriental Region, where they range from Bombay to the Philippines. The Palpimaninæ, the most specialised of the three, to which the Oligocene genus belongs, are represented by two groups, the Chedimeæ and the Palpimaneæ. The latter, containing the single genus *Palpimanus*, occurs in the Mediterranean Region, Western India, and East and South Africa; the former is represented by *Boagrus* in the Malay Peninsula, *Steriphopus* in Ceylon, *Sarascelis* in the Malay Peninsula and tropical West Africa, *Diaphorocellus* in South Africa, and by *Otiothops* and *Anisœdus* in South America. The survival of the primitive type, *Huttonia*, in New Zealand assigns great antiquity to this group. The Stenochilinæ and Palpimaninæ were perhaps evolved in South-eastern Asia and spread thence in a westerly direction, the more specialised Palpimaninæ reaching Europe in the Oligocene and passing into Africa and thence to South America. The entire absence of Palpimaninæ from North America and Australia, and the near relationship that obtains between the genera from South America and Tropical Africa, almost compels the belief that the former country received this element of its fauna from the latter.

The Anyphænidæ are represented in the Oligocene beds of Europe and North America. At the present time, one genus only, *Anyphœna*, occurs in the temperate area of the Northern hemisphere of the Old World; the same genus also occurs in North America; while the remainder of the genera, sixteen or so in number, extend into South America, principally along the Andean chain as far south as Tierra del Fuego. These facts suggest that the group had its origin in North America, perhaps in Eocene times, crossed thence into Asia and Europe before or during the Oligocene, and, when North and South America were